Momentum and Impulse (Chapter 9)
Law of Conservation of Momentum
Lab next class - explosions + collisions

Look at a cart mass 1.0 kg moving at 2.0m/s. If we drop another 1.0 kg on the cart, what is the speed of the cart after the mass is added?

Momentum
recall: inertia is the tendency to stay at the same speed and direction.related to mass.
momentum is different. It involves both inertia and motion.
symbol: p (why, why not - m is taken, greek work pneumatics - motion)
equation: p=mv
product of mass and velocity
units: kgm/s (change in momentum is given in Ns)
vector - direction is important

Impulse:
Newton's second Law
$F_{net}=ma=m(\Delta v/\Delta t)$
assumes mass is constant
$F_{net}=\Delta mv/\Delta t=\Delta p/\Delta t$
$\Delta p=F_{net}\Delta t$ = impulse=area under the F_{net} - t graph
another form of Newton's second Law that is more general - it includes problems where the mass is changing

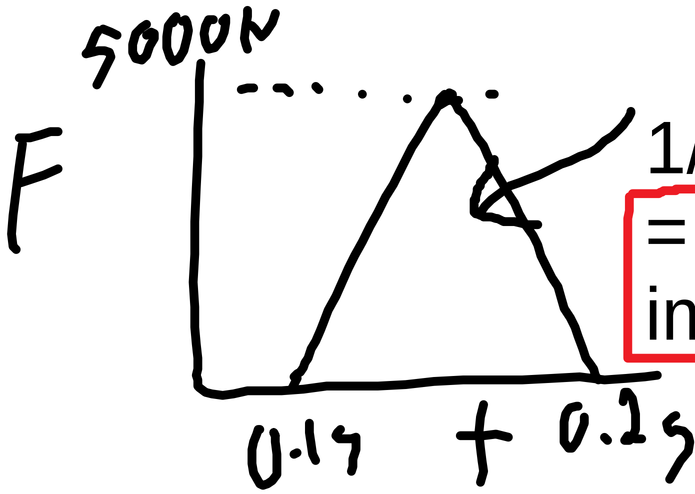
eg. You throw a 145g baseball at 95 miles and hour (95 miles/hour (1600m/1mile)(1hour/3600s)
95x1600/3600=42.2222 m/s
What is the impulse and force on the ball if
a) it comes to a stop over 0.20s in the catcher's mitt. pf-pi=impulse=Ft
b) it hits a window for 0.050s and goes through at 22m/s
c) it is hit by a bat and goes back at -52

m/s with 0.030s of contact time

d) if the force time graph looks like this:

area = impulse

1/2 basexheight



1/2 0.1s x 5000N

= 250 Ns of impulse

a) $\Delta p = p_f - p_i$ = 0 (the ball stops) - mv

= 0 - 0.145kg x 42.22 m/s =

-0.145x42.22=-6.1219

impulse = -6.1 kgm/s or Ns

N=kgm/s^2 Ns = kgm/s^2 x s=kgm/s

$\Delta p = F_{net}\Delta t$ so F_{net}=-6.1Ns/0.20s

F=-31N

b) $\Delta p = p_f - p_i$ =(0.145kg x 22m/s) - (6.122kgm/s)

0.145x22=3.19 3.19-6.122=-2.932

$0.145 \times 22 = 3.19 \quad 3.19 - 6.122 = -2.932$

impulse = -2.9 kgm/s

$F_{net} = -2.9/0.05 = -58N$

c) $\Delta p = pf - pi = (0.145kg \times -52m/s) - (6.122kgm/s)$

$0.145 \times 52 = -7.54 \quad -7.54 - 6.122 = -13.662$

impulse = -14 kgm/s

$F_{net} = -14/0.03 = -4.7 \times 10^2 N$

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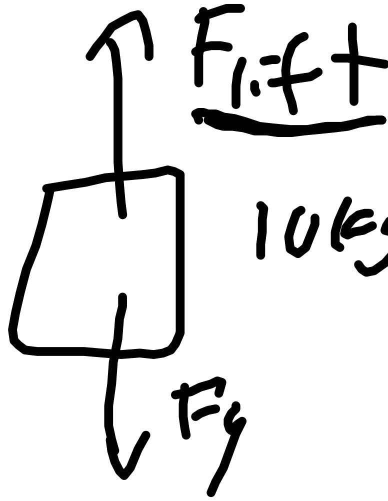
$F_{net} = ma = \sum F$

$7.0kg(4.0m/s^2) = F - 5N$

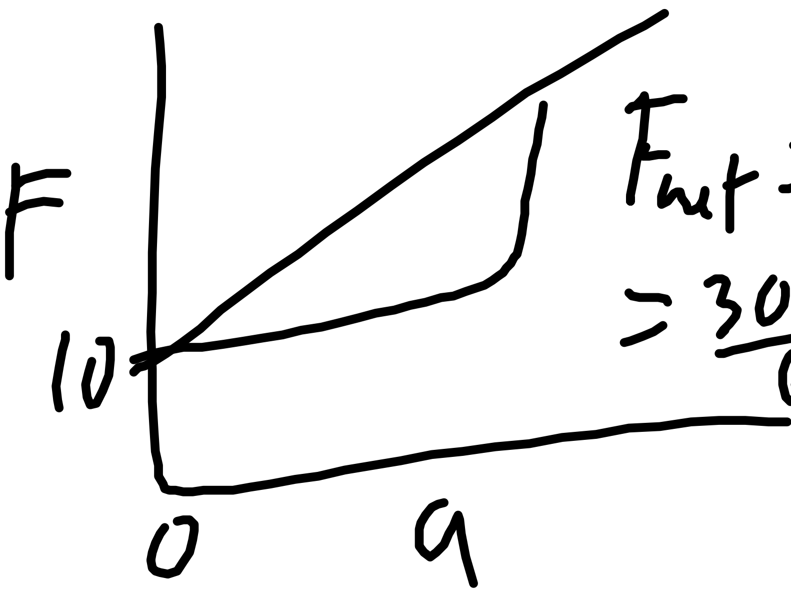
$F = 28 + 5 = 33N$

Q 7



$$ma = F_{lift} - F_g$$

$$F_{lift} = ma + mg$$



$$F_{net} = ma = F_a - F_f$$

$$= \frac{30\,N}{6\,m/s^2} = 5\,kg$$